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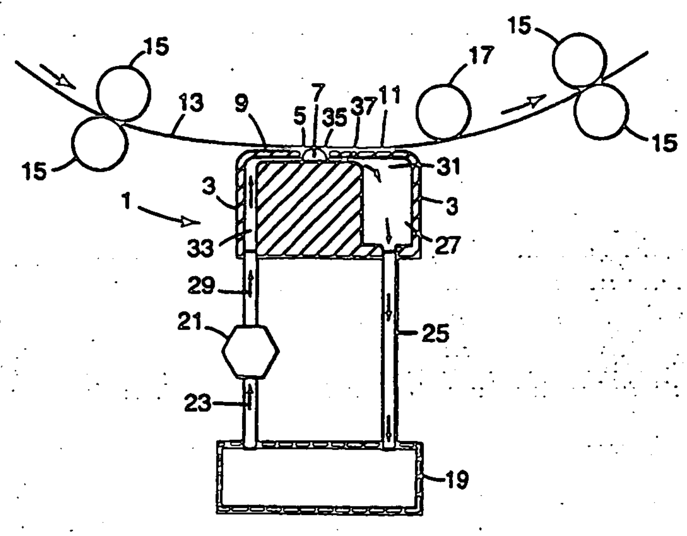

(57) Abstract

Apparatus (1) and process for the application of liquids (29) to photosensitive elements (13) comprising the steps of providing a coating head (1) with an upwardly facing slot (5) therein, providing a liquid (29) within the slot (5) evenly along its length, continuously moving a downwardly facing photosensitive element (29) over the slot (5) and contacting the element (13) with the liquid (29) within the slot (5), removing the photosensitive element (29) from the slot (5) with liquid (29) in or on the element (13), wherein the amount of liquid (29) provided to the slot (5) is more than the amount of the liquid (29) carried away from the slot (5), and excess liquid (29) is collected from the slot (5).

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SLOT APPLICATOR FOR PROCESSING SOLUTIONS

FIELD OF THE INVENTION

The present invention relates to applicating processes and apparatus for use in imaging technologies. The invention particularly relates to apparatus and processes for applying active chemistry to exposed photosensitive media, particularly developer, activator, and fixing chemistry to exposed silver halide imaging media.

BACKGROUND

Processing of conventional silver halide photosensitive materials has been and remains most commonly practised by the use of tanks containing the requisite processing solutions, through which the media is transported via a suitable arrangement of rollers and guides. The rotational movement of the rollers helps to agitate the media, along with impellers and recirculation pumps within the tank to achieve even processing. Despite the dominance of tank processing methods in commercial operation, some significant disadvantages are associated with this approach. By their nature, tank processors are susceptible to oxidation which reduces the lifetime of some chemistries. Additionally, tank processors usually contain large volumes to achieve the necessary processing times at acceptable transport speeds. Taken together, these drawbacks provide the additional requirement for high replenishment rates to maintain consistent results.

With the growth of laser imaged products, the operating environment is shifting from high capacity darkroom based machines, capable of processing a wide range of silver halide media, towards smaller, possibly dedicated machines able to operate under white light in an office-like environment.

There are a number of known examples of coating processes using a slot- or slit-like arrangement. An example of a slot type is commonly used for precision coating of photographic emulsions, for single and multi-layer applications. However, these are precision slots with a gap width of about 0.5mm and operate by supplying solution to the moving web at the same rate at which it is pumped. Another slit applicator was developed by Fairchild for the U.S. Navy (PS&E Vol 5 1961). This

consisted of a 70mm applicator head through which film passed to be treated. The viscous solution was fed into and retained within a slotted undercut which then coated the solution onto the emulsion as the film was pulled through.

US-A-3 372 630 and US-A-5079580 describe another group of coaters which have been described as slot coaters and which operate by a principle which requires passing the film through a narrow slit. The general arrangement of the applicators allows a narrow slit to be filled with solution which is transferred to the film as it is passed through the slit. Several configurations exist which are claimed to assist the uniformity of application and improve agitation. All of this group rely on passing the film through the orifice rather than over the top of the slit. Another variation along these lines is disclosed in US-A-5043756 which makes use of a double walled 'U' shaped tank of low internal volume, through which the film is passed to effect processing.

EP-A-525 886 discloses an applicator which consists of a slit orifice composed of a plurality of channels. The applicator has an integral manifold which distributes solution equally down the narrow channels which is then deposited onto the receiving film. In effect the delivery is made from a multitude of individual streams running down each channel, which then coalesce to form a continuous layer onto the film. There is no provision for the collection of solution overflow.

GB-821031 discloses apparatus for the application of liquid to the surface of a material comprising a processing head having a trough or recess provided with an inlet and an outlet opening for processing liquid, means for maintaining the material spaced at a short distance from the edges of the trough or recess, a reservoir for processing liquid, and means for applying suction to the trough or recess, through the outlet opening so that liquid in the reservoir can be drawn to the trough or recess while air is drawn into the trough or recess through the space between the trough or recess and the said material. The air layer formed by the suction is essential in obtaining turbulent flow in the processing head which ensures effective processing.

GB-2209228 discloses a system for the development of exposed silver halide film in which the film moves emulsion side up on conveyor, a viscous developer is applied to the film by gravity from a feeder with a series of openings located above a container and the moving film close to one end of the conveyor, blade is provided

adjacent the other end to remove excess unused developer, and squeegee rollers squeeze used developer off the film before rinsing and fixing the developed film. The developer may be applied via a narrow slit at the bottom of the container, where the slit is perpendicular to the direction of movement of the film. The uniformity of the development layer is attained by roof sections and above the moving film, the space being filled with developer by controlling the rate of supply of the developer and the distance between the roof sections and the conveyor.

BRIEF DESCRIPTION OF THE INVENTION

This invention relates to a novel method for processing imagewise exposed photosensitive media based on silver halide, in the form of films, papers, printing plates, etc. In a first aspect of the invention, there is provided a process for the application of liquids to photosensitive elements comprising the steps of providing a coating head with an upwardly facing slot therein, providing a solution within the slot evenly along its length, continuously moving a downwardly facing photosensitive element over the slot and contacting the element with the solution within the slot, removing the photosensitive element from the slot with liquid in or on the element, wherein the amount of the solution provided to the slot is more than the amount of the solution carried away from said slot, and the excess solution is collected from the slot.

The invention also provides an apparatus for applying solutions to photosensitive media comprising a housing, an upwardly facing slot within the housing, a means within the housing for providing liquids from a reservoir to the slot evenly along its length, transport means for transporting photosensitive media to the slot and placing the photosensitive medium in contact with solution within the slot, and means within the housing for removing excess solution from the slot. An insert may be present within said slot, said insert providing a rounded surface which faces said photosensitive element in contact with solution within said slot. The means for removing solution from the slot may direct the removed solution back to the reservoir, or to a separate collection means, and preferably is switched between these modes.

The processing step is carried out by transporting the photosensitive media across a coating head, the key component of which is a slot. Processing solutions are pumped to, and drained from the slot in the coating head. In normal operation, aspects of the design and pump rate of processing solutions to the slot allow a continuous and continuously replenished (or replaced) bead of the solution to form evenly along the entire length of the slot. Solution removed from this bead is imbibed by the medium and is used to process the photosensitive element.

The apparatus is suitable for all the stages of conventional silver halide processing, such as activated development, development, fixation, bleaching, and stabilisation. It is possible, but less efficient to perform a washing step by this process. Processing using the apparatus described in this invention provides many advantages over conventional tank processing, including reduced atmospheric exposure of chemistry, low volume usage of processing solutions, efficient agitation of solutions at the point of application of solutions at the slot and reduced unit costs for the processor.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional, isometric elevation of a slot coater; and

Figure 2 is a side cutaway view of the slot coating device and reservoir according to the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

This device of the invention can be used to treat any photographic material with liquid chemicals during the development, fixing, washing, activating and stopping process. Liquid solutions such as developers, fixers, wash water and activators can be applied to the photosensitive layer at the appropriate stage of processing via one or more applicator heads. The applicator heads are associated with suitable transport rollers which guide the film across the heads, following a suitable path which allows the film to make intimate contact with the top face of each head. The transport system also allows film to pass through at a constant rate over each coating head in turn through the entire process. A limited and controlled

application of solution is made at each head which effects a thin coating of solution over the photosensitive layer.

A separate applicator head may be provided for the application of each of the different solutions required in the various stages in the processing of the film, the device thus comprising a series of applicator heads spaced apart by a distance sufficient to enable each stage of the processing cycle to proceed to completion before the relevant portion of the film arrives at the next applicator head. The spacing required will obviously depend on the rate at which the film is transported through the device, and both the spacing and the transport rate may be adjustable to suit different circumstances. Two or more consecutive applicator heads in the series may be dedicated to the same stage of the processing cycle (e.g., development), which may enable a faster throughput.

Optionally, one or more applicator heads in accordance with the invention may be used to effect only part of the processing cycle (e.g., development only, or development and fixing), with the remainder being accomplished by conventional means such as bath processing, spraying etc.

Because of the simplicity of the system, the process is applicable to many different dimensions of media, e.g., of up to 200mm in width. To ensure even distribution of liquid over the surface of the media and even replenishment at the application zone of liquid to the media, conventional fluid mechanics and design considerations may be applied to the apparatus. For example, the slot may be wider at its edge portions than in the centre to ensure even flow of liquid to the edges of the media at the application point or within the application zone. Alternatively, or additionally, a manifold may be used to supply liquid evenly to the entire length of the slot.

It is desirable to pump slightly more liquid (e.g., activator solution) into the slot than is actually absorbed or imbibed by the medium. This ensures that there will always be sufficient liquid within the application zone to meet the demands of the system. Surplus solution may be recycled into the reservoir by collection in drains, the overflow or excess liquid of such drains being directed to the reservoir. This overflow liquid is minimally contaminated by contact with the medium, but if contamination is detected, and that contamination at any time is excessive, or if the

composition within the reservoir is not in proper chemical balance, the solution in the overflow may be directed away from the reservoir for separate replenishment, cleaning or disposal.

Certain measures are desirably taken to promote good and uniform contact of the film with the applied solution. Film should move in a path which is arcuate (i.e., convex towards the slot coater) to keep pressure against the slot or the surface of the housing which defines the slot. By having the leading edge or plane of the film strike the surface in advance of the slot while maintaining a convex profile, the required pressure is maintained. This helps to ensure effective contact of the medium in the slot application area. A slip coating can be provided on the surface of the housing in advance of the slot, to ensure smooth movement and non-abrasion of the film. Films of polytetrafluoroethylene and other slip materials are useful for that purpose.

There may also be a slot insert which can be present in the slot to ensure that the flow of liquid in the application zone is properly controlled. The insert can be a bar or semi-cylindrical bar with the rounded end facing upward (towards or into the slot). The insert may contain absorptive or carrier material to wick or support liquid at the point of application (e.g., gauze, reticulated foam, mesh, etc.).

The processes of the present invention are particularly suitable for use in the application of activator or "spiked" activator solutions to silver halide imaging media such as diffusion transfer imaging media as disclosed in U.S. Patent Nos. 4,062,041 and 4,784,933. These activator solutions are relatively high pH solutions (pH greater than 9.0 up to 12.5 or higher) which, in the case of spiked activators, also contain some developer in the activator solution. The process and apparatus are also found to be useful not only for activators, but also for other active solution applications. The process and apparatus of the present invention are particularly useful for activator systems because of the fact that activators need to be in contact with the imaging medium for only a brief period of time as compared to developer solutions or other active solutions.

The applicators of the present invention are also very useful for applying fixer solution. Systems have been used where the fixer solution is applied in a straight line arrangement after application of the activator. Conventional processing units generally have series of rollers which direct the film in turns of about 90 and 180

degrees towards the various baths or applicators. In straight line processing, as in the present invention, the film need not ever be turned more than 90 degrees, preferably not more than 50 degrees, more preferably no more than 40 degrees, and most preferably less than 20 degrees between any two solution applications, particularly between the activator and fixing applications.

Silver halide systems which are particularly susceptible to development with the process and apparatus of the present application include diffusion transfer systems (for which activator developing systems are well known), and graphic arts media (particularly those with high silver chloride content, such as greater than 75% AgCl, more preferably greater than 80% AgCl, and most preferably greater than 90% and up to 100% AgCl).

The process and apparatus of the present invention can also provide other benefits towards reducing the amount of solutions which need to be used in the processing of given amounts of media. It is readily possible to heat the solution immediately before application, and the heating may be performed on only those amounts needed for delivery. In a preferred embodiment, the amount of heated solution is the amount imbibed by the media and some modest overflow which is returned to the reservoir.

In conventional bath or tank processors, the entire volume of processing solution must be continuously maintained at the working temperature, and so higher working temperatures lead to higher energy costs. Moreover, photographic processing solutions (especially developer solutions) are known to deteriorate rapidly if held at high temperatures for extended periods. In the apparatus of the invention, only a minimal volume of solution is heated at any one time, and a given volume of solution is held at elevated temperatures for only a short time, e.g., a few seconds. Hence, energy costs arising from heating the solutions are low, and the risk of accelerating the decomposition of processing solutions is minimised. For these reasons, it is possible to carry out the processing at higher temperatures than would normally be possible using conventional equipment, and hence gain an increase in throughput. Because lower volumes of liquid are applied, there is less potential for excessive softening of gelatin layers by the heat content of the applied solution, as could occur in a heated immersion bath. A cooling device (such as a Peltier element)

may also be used on the means for returning overflow or excess to the reservoir so that heated liquid is not returned to the reservoir.

The invention is hereinafter described in more detail by way of example only with reference to the accompanying drawings in which:

Figure 1 shows a basic slot coating apparatus 1, comprising a frame (or housing) 3 having an upwardly facing slot 5. Film (or photosensitive element) 13 which is to be treated with solution (arrow 29) is directed by nip rollers 15 and a guide roller 17 against an advance surface 9 of the frame 3 in advance of the slot 5. As shown in Figure 1, the film is arcuate as it approaches the advance surface 9, and describes a path which is convex towards the apparatus 1. The solution (or liquid) 29 enters the slot coater 1 through a duct 33 and exits the slot coater through a duct 31. The materials used for construction must be inert to any solutions used and possess sufficient mechanical strength to maintain the integrity of the assembly.

In the assembled form the construction can be divided into three sections: solution feed, coating, and solution drain. Solution 29 is fed into one side of the head 1, forced up to the slot 5 evenly doing the length of the slot where the coating takes place and any excess solution drained away from the opposite side. The coater head 1 contains two ducts (23, 25) or nozzles (not shown) for input and output of solution, situated in the lower half of the body 1. Solution 29 fed into the input side via a pump 21 may enter a manifold (not shown) before being fed up to the slot 5.

The slot 5 itself is a gap of some 1-15 mm (e.g., 5mm), although a range of 3-10mm is preferred, which may have a length equal to the entire width of the coater and is capable of coating film up to a maximum width dimension equal to this length. Situated below the slot 5 in Figure 2 is a semicircular bar insert 7 which is also about as wide as the slot 5. Solution 29 fed up from the manifold (not shown) is directed up and over the insert 7, following its profile.

In another embodiment of the invention the semicircular bar 7 is replaced with a circular bar (not shown). This also would be located into a slot of width just large enough to accommodate the bar and deep enough to seat the bar down sufficiently so as to produce a similar profile to that of the semicircular insert 7.

Due to the close proximity of the insert 7 and slot 5, solution fills the gap creating a lengthwise bead of liquid (not shown). The gaps between the bar insert

and the edges of the slot 5 are adjustable to allow production of the desired bead in the slot for a range of solution viscosities and flow-rates. The bar 7 may be adjusted by altering the height of two adjustable screws (not shown), one at each end, on which the bottom of the bar sits. A typical operating range of gap width is 0.1 - 2.0mm. At the back edge 35 of the slot 5, between the rear portion of the top plate 11 and insert 7, is a gap 37 which allows solution 31 to drain away to a shallow trough 27 in which a small amount of solution (not shown) can collect. From here the liquid may drain away via outlet nozzle(s) 25, either by pumping or by action of gravity. This used solution 31 can be either returned to the feedstock reservoir 19, or go to waste disposal (not shown).

The drive system for the film is via a suitable set of (e.g., rubber faced) rollers 15 of the type used in conventional processing systems. These are arranged on each side of the coating head 1 to provide a feed and take-up of the film 13 over the head. In addition to the rollers 15 some appropriate fixed guides (not shown) may be required to achieve the correct feed path on to and off the head. Two pairs of driven pinch rollers 15 are the minimum requirement for each slot, although for multiple slot systems (not shown) a pair of rollers between slots can be shared by both applicators. The path length between rollers is required to be somewhat shorter than the minimum length of film to be processed, allowing the take-up rollers to grip before the feed pair let go.

The film 13 is fed with the photosensitive layer (not shown) facing down so that this side makes contact with the solution in the slot 5. In one embodiment, rollers guide the lower side of the film (usually the side which is to be treated, i.e., the photosensitive side) down initially, bending the film medium such that it is in compression. The film is then re-directed by rollers and guides so that the lower side of the film is now in compression such that on reaching the front edge 9 of the coating head there is a slight force (elastic recovery) which holds the sheet down onto the top of the head. The exit side of the head can be of a very similar arrangement to the entry side, although an additional roller is required to hold the film onto the head towards the back edge.

The path followed by the film as it passes over the coating head(s) is essentially horizontal, with the side to be treated with processing solution facing

downwards, although some deviation in either direction can be tolerated. However, it will be appreciated that the further the coating leads themselves are tilted from the horizontal, the greater will be the risk of leakage of processing solution.

The action of the bead which forms in the slot is such that a thin layer of solution forms between the head and film. Capillary action forces some solution back towards the front edge and by the dragging action of the moving film a thin layer is also produced after the slot. The combined effect of the different stages produces a film which is coated with a thin layer of solution. This layer remains on the surface until removed by either a squeegee action of a roller pair or displaced by a later treatment.

The supply rate of solution to the slot is an important parameter and is directly related to the film transport speed over the head for optimum coating performance. In order that a film be properly processed a certain minimum quantity of solution is required, namely the volume taken up by the gelatin plus the layer carried away on the film surface. The solution supply rate in conjunction with the film transport speed must at least satisfy this minimum requirement. For best results it is necessary to supply at a rate somewhat greater than the minimum required. The excess supplied overruns into the drain to be recycled. Typical pumping rates are in the region of 10-50cc/100mm of slot at a film transport speed of 3-6mm/sec. Pumping need only be initiated just prior to the arrival of the leading edge of the film and cease as the back edge leaves the slot region. This feature helps with reducing atmospheric oxidation as no solution is in contact with the surrounding air whilst the pumps are inoperative. Timing of the pump duty cycle can be achieved by the placement of suitable film detectors just prior to the coating head, which will allow for a suitable priming time of the slot with solution before the arrival of the film.

Temperature is a very important parameter in photographic processing and requires close control to obtain consistent results. The slot applicator has a major advantage in this respect over conventional tank processors in that solution can be brought up to the required temperature within the body of the head. This means that the solution is heated as required just prior to application to the photographic film. This in turn provides for a much longer chemistry life, as large tanks of developer and activator held at elevated temperatures suffer from rapid oxidation. Electrical

heating elements (not shown) are installed into the delivery manifold region to provide the heat energy and are controlled via temperature sensors near the slot. Alternatively a heat exchanging system could be employed in which heated solution (e.g., water) be pumped through the body of the head, totally separated from the photographic solutions. The heat energy given out by the water heats the head body which in turn heats the photographic solutions. In the latter example it would be beneficial if a substantial portion of the head body be made from a good thermal conductor (e.g., metal or some ceramics) to assist the process of heat transfer and to provide a thermal mass, which will help to even out minor temperature fluctuations. In the case of high temperature processing (greater than 35°C) an advantage may be gained by part heating the solution to some intermediate temperature, at which atmospheric oxidation rates are low, and then to bring the solution up to the desired temperature in the body of the head, by the means already described.

In a further embodiment, the circular insert is covered with a layer of meshed material so that the outer surface which comes into contact with the processing solutions is completely covered. Such an addition effectively increases the diameter of the bar, which then requires re-adjustment to restore the original slot gaps, although the highest point of the insert is still below the level of the film plane during operation. The effect of the mesh is to wick the solution across the gap width and assist in the even distribution of solution onto the film during the coating process. Because of the high surface area of the mesh, it has water attracting properties which assist in stabilising the bead which forms. The mesh material must be compatible with the solutions being used e.g., stainless steel, polyester and nylon are good examples, but by no means the only suitable candidates. Mesh sizes may influence the effectiveness of addition. A range of 20-200 counts/inch is the most appropriate.

To operate as a complete system at least one slot coater is required for each of the chemical treatment stages of processing. Should any stage require additional treatment, two or three slot coaters could be arranged in series to provide for this. It is also envisaged that a slot coater could be used within a system which uses conventional bath processing, replacing one or more of the processing stages with a slot coater.

Examples

The example apparatus included a suitable transport system to guide the film over the slot at constant rate: speed adjustable from 2.5 to 17.0 mm/s. The pumps used to deliver and drain the solutions were of the peristaltic type which were connected to the slot coater via poly(vinyl chloride) tubing, a separate circuit being used for solution delivery and drain. Flow rate to the slot was controlled from the pump and was set at a rate which allowed for the formation of a continuous bead across the width of the slot. Prior to processing, the delivery lines were primed by pumping until solution could be seen to be forming at the slot and the tubing was free of air bubbles. Once primed, the coater could be left in this state ready to receive film material.

The operation of the pumps was controlled manually, although such a system is ideally suited to full automation with appropriate sensors to detect film location relative to the slot. A sheet of photographic film to be processed was fed into the first set of pinch rollers and fed down to the slot. Just prior to the film reaching the slot the delivery pump was activated, closely followed by the drain pump. Both pumps were left operating until the back edge of the film left the slot region, whereupon both were switched off. The same procedure was adopted no matter which stage of the processing cycle was being performed.

Due to the short processing times required the slot coater is particularly suited to activated processing; high pH solution being used to trigger development from a layer coated under the emulsion which carries the developer. A small quantity of activator of high pH uniformly applied is sufficient to trigger development and process to a suitable image density. Photographic emulsions of a composition high in chloride and low in bromide have particularly short processing times (< 5 seconds) and may be processed to full density by passing over the slot at a rate of ~10mm/s and a supply rate of 50cc/min. In this example the activator was not recycled, i.e., only fresh solution was supplied to the slot. Fixing and washing was by conventional bath process. Repeated tests over 10 separate sheets of exposed film produced the following results:

	Avg	SD
D-min	0.061	0.007
Sp-1	1.975	0.018
Sp-2	1.858	0.017
Sp-3	1.597	0.014
TH-1	0.698	0.039
TH-2	1.541	0.086
TH-3	5.95	0.31
Con-1	3.99	0.118
Con-2	2.99	0.45
D-Max	4.141	0.104

Sp-1 speed point measured at 0.1 + dmin
Sp-2 speed point measured at 0.2 + dmin
Sp-3 speed point measured at 1.0 + dmin
TH-1 contrast (gradient) between points 0.07 + dmin and 0.17 + dmin
TH-2 contrast between 0.17 + dmin and 0.37 + dmin
TH-3 contrast between 0.50 + din and 2.50 + dmin
Con-1 contrast (gradient) between points 0.1 + dmin and 2.5 + dmin
Con-2 contrast (gradient) between points 1.6 and 4.0 absolute density

These sensitometric data compare well with those obtained from bath processing.

In the case of emulsions which have a higher bromide content, processing times are increased to allow for the reduced rate of development. A typical emulsion used for laser scanning applications may have a bromide content of 35%. To achieve full development with these emulsions, coated with the developer incorporated underlayer, and again using a high pH activator processing, speeds as low as 4mm/sec are necessary to produce full development, with activator pump rates of 50mls/min.

Developer processing

In this example, a standard developer solution (DRC-V developer solution from Imation Corp., Oakdale, MN -- formerly a portion of 3M Company, St. Paul MN) was applied to an exposed conventional film (DRC-P film from Imation Corp., Oakdale, MN -- formerly a portion of 3M Company, St. Paul MN). Due to the longer processing times necessary the film transport speed of 5mm/s was used at developer delivery rates of 50mls/min. At 25°C a single pass produced a D-max of about 1.5, compared to the standard of 4.5 processed conventionally. Passing a piece of film

over the head twice gave a value of 3.7, i.e., still under developed. Heating the developer to 38°C gave a D-max of about 4.0 with a single pass whilst concentrating the developer by not diluting 1+4 with water gave about 2.8 with a single pass and 4.42 with two passes, both at 35°C. From this it can be concluded that a more concentrated developer solution running at the correct temperature (35°C) is capable of achieving a performance close to the standard by a double pass over the head. This mimics a single pass over two heads in series.

CLAIMS

1. A process for the application of a liquid 29 to photosensitive elements comprising the steps of:

providing a coating head 1 with a generally upwardly facing slot 5 therein, providing a liquid 29 within the slot 5 evenly along its length:

continuously moving a generally downwardly facing photosensitive element 13 over the slot 5 and contacting the element 13 with the liquid 29 within the slot 5; and

removing the photosensitive element 13 from the slot 5 with liquid 29 in or on the element 13, wherein the amount of liquid 29 provided to the slot 5 is more than the amount of the liquid 29 carried away from the slot 5, and excess liquid 29 is collected from the slot 5.

2. The process according to claim 1 wherein the liquid 29 is an activator liquid for silver halide development and said photosensitive element 13 is a silver halide photosensitive element with a silver halide emulsion on a support, the emulsion being positioned between the support and the slot 5 when said photosensitive element 13 contacts said liquid 29 within the slot 5.

3. The process according to claim 1 wherein an insert 7 is present within the slot 5, and said liquid 29 moves over the insert 7.

4. The process according to claim 3 wherein the insert 7 has a rounded surface which faces said photosensitive element 13.

5. The process according to claim 1 wherein the photosensitive element 13 is bent to hold the element 13 in contact with the coating head 1.

6. The process according to claim 1 wherein the amount of said liquid 29 provided to the slot 5 is no more than twice the amount of said liquid 5 carried away by the element 13 when leaving the slot 5.

7. The process according to claim 6 wherein the amount of said liquid 29 delivered to the slot 5 is less than 120% the amount of said liquid 29 carried away by the element 13.

8. An apparatus 1 for applying liquids to a photosensitive element comprising:

a housing 3 defining a generally upwardly facing slot 5,

means within the housing 3 for providing liquid 29 to the slot 5 evenly along its length;

transport means for transporting the photosensitive element to said slot 5 and placing said photosensitive element 13 in contact with liquid 29 within said slot 5, and for transporting the photosensitive element 13 away from the slot 5 with liquid 29 therein or thereon; and

means within the housing 3 for removing excess liquid 29 from said slot 5.

9. The apparatus 1 according to claim 8 additionally comprising an insert 7 positioned within said slot 5, said insert 7 having a rounded surface which faces said photosensitive element 13 in contact with said liquid 29 within said slot 5.

10. The apparatus 1 according to claim 8 additionally comprises:

reservoir 19, wherein said means for removing liquid 29 carries liquid 29 removed to said reservoir 19;

heating means for heating said liquid 29 prior to said liquid 29 reaching said slot 5; and

cooling means for cooling excess liquid 29 removed from said slot 5.

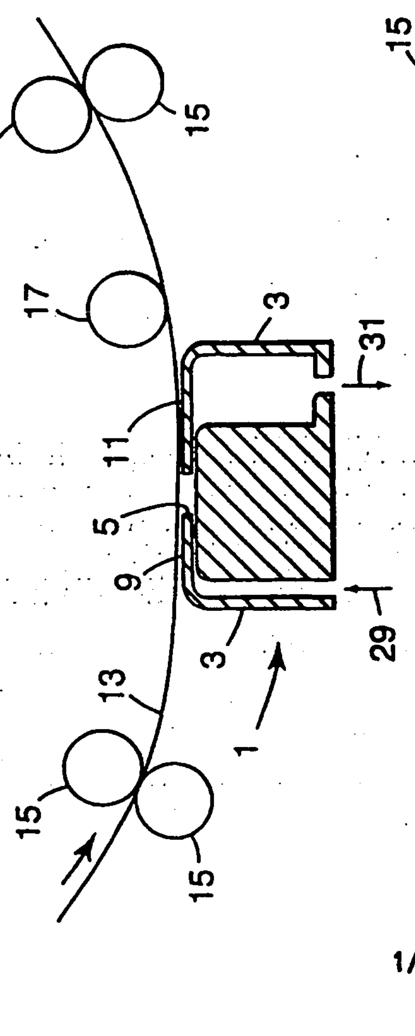
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Fig.1

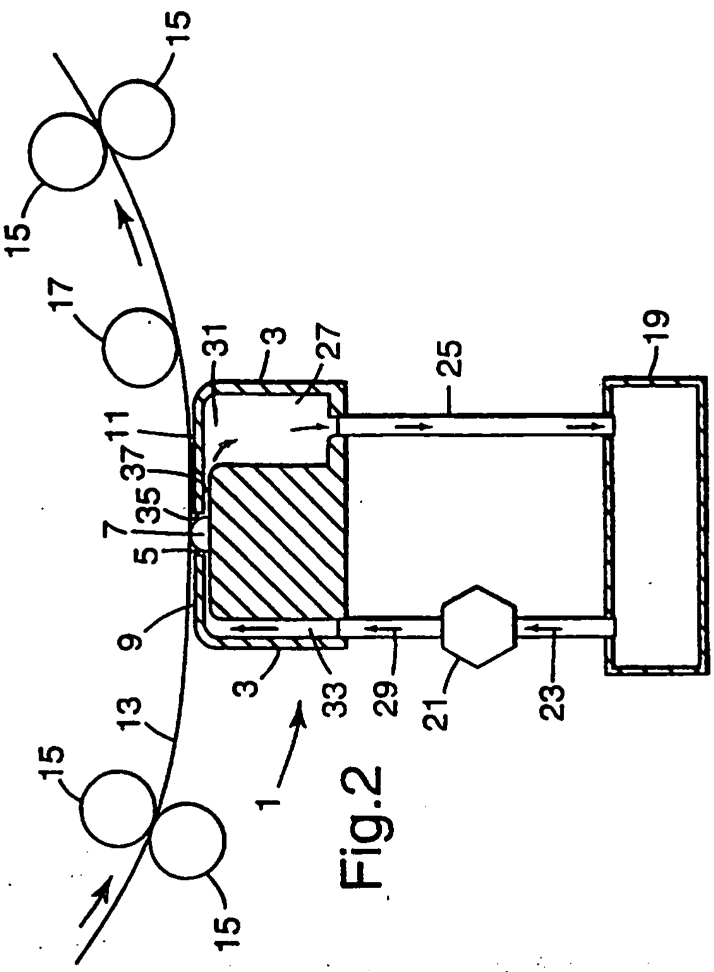
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Fig.2

INTERNA' ONAL SEARCH REPORT

Inte. nal Application No
PCT/US 96/20097

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G03D5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 281 620 A (MCCHESNEY ET AL.) 4 August 1981	1-3,5,8
A	see abstract; figure 7	4,6,9,10

A	US 3 721 175 A (NEEDLEMAN) 20 March 1973 see claim 1; figure 7	1,8

A	WO 91 08519 A (DELPHI TECHNOLOGY) 13 June 1991 see abstract; figure 8	1,8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
7 April 1997	16.04.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Romeo, V

INTERN.. IONAL SEARCH REPORT

Information on patent family members

Inte onal Application No
PCI/US 96/20097

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